Date: **November, 30th, 2011**

Title: The Next Generation of Ecological Indicators: Defining Which Microbial Properties Matter Most to Ecosystem Function and How to Measure Them

Short Title: Next Generation Indicators

PI Contact: ***Edward K. Hall** (ehall@usgs.gov, 970-491-2153) – *corresponding PI
Matthew Wallenstein (mawallen@nrel.colostate.edu, 970-491-1623)
Natural Resource Ecology Laboratory, Colorado State University
Campus Delivery 1499, Fort Collins CO 80523-1499

Jay Lennon (lennonja@msu.edu, 269- 671-2340)
W. K. Kellogg Biological Station, Michigan State University
Hickory Corners, MI 49060

Project Summary:

While it is widely recognized that microorganisms are intimately linked with every biogeochemical cycle in all ecosystems, it is not clear how and when microbial dynamics constrain ecosystem processes. As a result, it is know clear how to apply the value of increasingly detailed characterization of microbial properties to our understanding of ecosystem ecology. Several recent papers have demonstrated how information about microbial dynamics can be incorporated into ecosystem models (Allison et al. 2010, McGuire and Treseder 2010, Todd-Brown et al. 2011a), but it is generally not clear what types of microbial data are most useful in explaining variation in biogeochemical processes and ecosystem functioning, especially in the face of global change. There is a clear need to quantitatively evaluate which microbial data are best suited to improve our ability to predict ecosystem processes, and to direct future sampling efforts toward emerging approaches that are most likely to advance our understanding of ecosystem functioning.

The USGS has a storied legacy of collecting important metrics for quantifying and describing our nation's resources. The potential for microbial processes to provide further insight into the controls of ecosystem function has spurred the development of a growing group of USGS scientists conducting research on environmental microorganisms. In line with these efforts, we propose to use existing datasets describing microbial properties and ecosystem function to address which microbial processes are most likely to enhance our understanding of ecosystem processes and their projections in a changing world. **Our overall goal is to identify key microbial indicators of fundamental ecological processes, which will help to focus future monitoring and research efforts from the USGS and the broader scientific community**.

Proposed Start Date and End Dates: July 2012 – January 2014

Proposed Data Release Date: October 2013

This is a first time submission.

Conflict of Interest: PI Hall is actively collaborating with Jill Baron. Beyond this we have identified no conflict of interest with any member of the scientific advisory committee.

I. *Problem Statement*

Decades of research have elucidated many of the key abiotic drivers of ecosystem processes by describing relationships between abiotic parameters and process rates. While this approach will continue to produce new insights, we are approaching a time when additional data describing abiotic conditions may contribute less to the understanding and prediction of larger-scale ecosystem processes. New insights are more likely to be gained from novel approaches that synthesize emerging datasets and in doing so, develop frameworks for extending our understanding beyond current paradigms (Schmidt et al. 2011).

Microorganisms are the principal mediators between abiotic drivers and ecosystem processes (Figure). They are responsible for the transformation of nutrients, decomposition of organic matter, and degradation of contaminants in terrestrial and aquatic ecosystems. Because microbes integrate drivers and processes, microbial ecology is a potential source

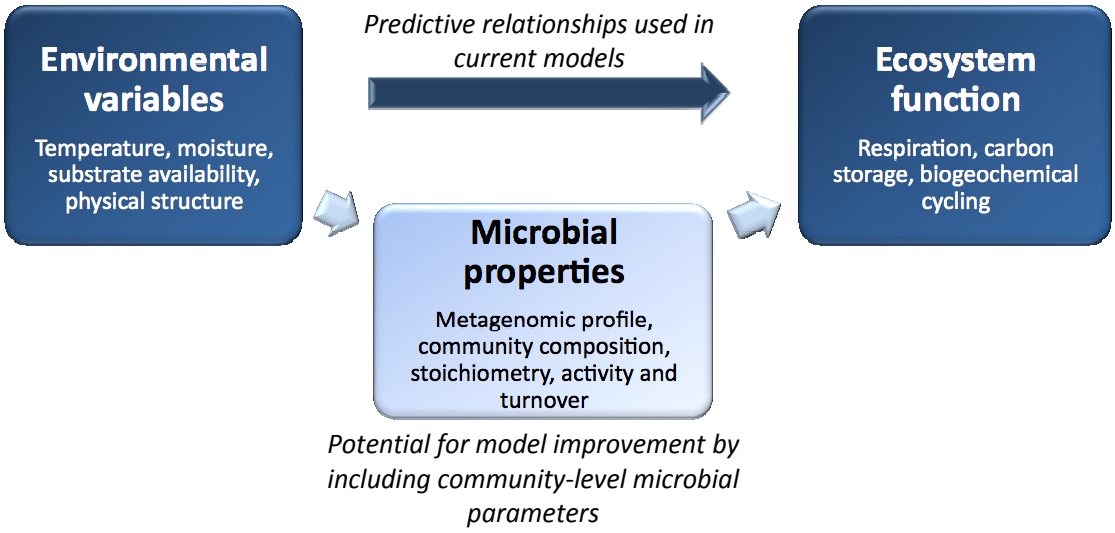

Figure – Illustrates the incorporation of microbial community properties into our understanding of how abiotic drivers interact with ecosystem processes

of new data for advancing paradigms in ecosystem ecology. ***We propose that unique properties of microbial communities can capture variation in ecosystem-scale processes that can not be accurately captured by abiotic environmental parameters alone.*** Many specific examples show that differences in microbial properties may result in changes in ecosystem relevant rate processes among sites with similar environmental conditions. For example:

1. Denitrifying communities inhabiting different soils differ in their sensitivity to oxygen resulting in different rates of denitrification under similar redox conditions (Cavigelli and Robertson 2000).
2. Decomposer communities are able to degrade their 'home-field' litter faster than native communities (Ayres et al. 2009).
3. Microbial communities differing in composition degrade litter at different rates (Strickland et al. 2009), and produce different metabolites when decomposing a common leaf litter (Wallenstein et al. 2011).
4. Lake bacterial community stoichiometry changes with mean annual temperature with potential to alter the microbial role in nutrient cycling (Hall et al. 2009)
5. Microbial communities have also been observed to locally adapt to warming (Bradford et al. 2008), fluctuations in redox status (DeAngelis et al. 2010), and to altered precipitation regimes (Szukics et al. 2010, Evans and Wallenstein 2011).

Although this evidence suggests that measurable properties of microbial communities could differentially constrain ecosystem processes, it is still unknown which properties of the microbial community can best inform us about when microbes are likely to constrain ecosystem processes (Wallenstein and Hall 2011). As a working group, we propose to synthesize knowledge of microbial and ecosystem ecology, using a variety existing datasets that link community level microbial properties to ecosystem function. These data will alllow us to examine whether inclusion of microbial properties can improve our ability to explain variation in ecosystem level process rates. Below, we have identified a suite of candidate community level properties that may serve as important indicators of how ecosystems will respond to environmental transitions.

II. Proposed Activities - Candidate Microbial Community Properties

1. **Metagenomic properties of microbial communities**

Recent advances in DNA sequencing technology that describe genomic properties of environmental microbial communities have led to large efforts to characterize genetic diversity of microbial communities from a wide range of environments. A few studies have used genomic parameters to provide an index for microbial constraint of ecosystem function. For example, although the abundance of certain functional genes have previously been used as reliable indicators for biogeochemical *potential* (e.g. nitrification, methanogenesis) several more recent studies suggest that gene abundance can contribute to explaining *actual rates* of nitrogen and methane cycling (Wang et al. 2011, Braker and Conrad 2011, Wagner et al., 2003). Although these studies provide evidence that these genomic properties have the potential to be used as indicators of microbial community function, there has yet to be a large-scale effort to test which metagenomic parameters best link microbial properties to ecosystem function. With the advent of new efforts to coordinate sampling efforts (e.g.www.earthmicrobiome.org) and standardize metadata (Yilmaz 2011), it is now feasible to test these measurements and investigate their potential for providing insight into ecosystem function (Mackelprang et al. 2011).

Synthesis Approach: To test whether functional genes and phylogenetic information contained in metagenomes inform predictions of ecosystem function, we propose to use data from the recently initiated Earth Microbiome Project (EMP) with which group member **Jansson** is closely associated (Table 1, D1). The EMP represents the largest environmental microbial metagenome sampling effort to date, containing 10,000 environmental samples from various locations around the world, with standardized metadata describing geographical properties, soil characteristics (e.g. pH, soil C content), and environmental variables (e.g. soil moisture) (Cole et al. 2010, Yilmaz 2011). In addition, it is likely that other databases (e.g. MG-RAST) will soon adopt these standards, allowing us to independently test the generality of our results with additional datasets as they become publicly available.

2. **Coarse phylogenetic properties of microbial communities**

One challenge for the application of environmental metagenomics to ecosystem ecology is to identify the level of genomic resolution that is relevant to ecosystem function. In addition to the potential for high resolution metagenomic analysis to inform us about ecosystem processes, microbial community composition has been shown to vary across environmental gradients at relatively coarse phylogenetic levels (Phillipot et al. 2010, Fierer et al. 2005, Strickland and Rousk 2010). Described metabolic differences among microbial domains suggest changes in abundance will likely influence microbial community function (Bardgett and McAlliser 1999, Six et al. 2006, Keiblinger et al. 2010). However, there are few studies that have extended beyond identifying correlations to test mechanistically whether microbial communities described at this level can improve our understanding of ecosystem function (see review by Strickland and Rousk 2010).

Synthesis Approach: In addition to testing the predictive ability of domain-level abundance

with metagenomic datasets, we will also use larger datasets describing fungal:bacteria ratio using phospholipid fatty acids (PLFA) and corresponding biogeochemical rates. Team member Waldrop has access to a large dataset of microbial PLFA with associated detailed soil chemistry data collected as part of the USGS Geochemical Landscape Project (Table 1, D2). Because description of microbial communities with PLFAs preceded microbial molecular analyses by decades, the PLFA datasets are more robustly complemented with associated biogeochemical data (e.g. soil respiration, nitrogen mineralization etc.).

3. Microbial stoichiometry

Microbial stoichiometry is an emergent property of microbial communities that has important implications for ecosystem level nutrient cycling. A well-developed theoretical framework suggests that biomass stoichiometry of planktonic organisms should be inversely related to their resource stoichiometry (Elser and Urabe 1999). There is now strong evidence suggesting that this mechanism is applicable to microbial communities and may play a central role in the availability of limiting nutrients in a broad range of ecosystems (Hall et al. 2011). For example, a survey of 100 lakes in the north central U.S. indicated that soluble reactive phosphorus (SRP), a nutrient that commonly limits primary productivity in lake ecosystems, was inversely correlated to bacterioplankton community biomass P:C (Hall et al. 2011). Similarly, a large data set (60 globally distributed locations, 55 litter types, 2,800 observations) of terrestrial litter decomposition showed that microbial community function switched between immobilization and mineralization of N when the stoichiometry of the litter approached the stoichiometry of the microbial biomass (Manzoni et al. 2008). These studies suggest that there is an intimate link between microbial biomass stoichiometry and ecosystem scale nutrient recycling in a broad range of environments.

***Synthesis Approach*:** To address the effect of microbial stoichiometry on ecosystem processes, we will use an aquatic dataset of > 100 lake ecosystems from a wide range of trophic states and land-use categories that include bacterial C:N:P ratios as well as community metabolic rates (growth and respiration) and a wide range of environmental variables (temperature, phosphate, dissolved nitrogen) (described in Cotner et al. 2010 and Hall et al. 2009). In addition, group member Cotner has been collecting data from both natural environments and experimental chemostats on microbial stoichiometry for nearly two decades. As part of his research program, he has assembled measurements of microbial and resource stoichiometry from microbes in both marine and freshwater ecosystems from the North Atlantic Ocean to the Laurentian Great Lakes and small hypertrophic wetlands in the Prairie Pothole Region. Each of these data (currently independently maintained) are associated with complementary environmental and biogeochemical measurements.

4. Microbial dormancy

Since the 1970's it has been recognized that a potentially large fraction of the microorganisms in nature are metabolically inactive (Stevenson 1978). Studies using more contemporary techniques have since confirmed this, revealing that at any given time only a subset of the taxa in a microbial community may be responsible for the biogeochemical processes measured in nature. For example, recent studies suggest that ~90% of the bacterial cells and that ~50% of the bacterial "species" in soils are inactive or dormant (Lennon and Jones 2011). These levels of dormancy should have important implications for understanding the contribution of microbial communities to ecosystem functioning. On the one hand, "seed banks" of dormant microorganisms may contribute to patterns of seasonal succession, recovery from disturbances, and stability of ecosystem processes. On the other hand, by including dormant taxa in the characterization of microbial communities, we may be obscuring the relationship between active microorganisms and the biogeochemical activities that they help catalyze.

Synthesis Approach: To address questions related to dormancy we will compile unpublished and published datasets that quantify the fraction of dormant and dead bacteria

in different ecosystems using "vital" stains that indicate active respiration of microbial cells (Lennon and Jones 2011). In addition the large lake dataset to be used for the stoichiometric analyses contains measurement of percent of active cells for approximately 70 North American lakes. Finally, with data provided by group member Jansson we will mine existing shotgun metagenome databases for known dormancy genes. For example, we will look for toxin-antitoxin modules that are responsible for entrance into dormancy; sporulation genes, which allow some bacteria (i.e., Firmicutes) to enter dormancy; and resuscitation promoting factors (Rpf), which are proteins in some bacteria (Actinobacteria) that are responsible for terminating dormancy (Lennon and Jones 2011). This multi-faceted approach to conduct a comprehensive analysis of microbial activity in a wide range of ecosystems is unprecedented and will provide novel insight into how microbial activity is related to fundamental ecosystem level rate processes.

5. Additional candidate community properties

As a group, we will also explore additional community level properties likely to influence ecosystem function that can be obtained from these and other datasets. For example, biofilm formation by soil microorganisms may manipulate soil moisture (Lennon et al. in revision), an important driver of soil respiration (Suseela et al. 2011, Orchard and Cook 1983). The ability of microbes to form biofilms may be conserved on a taxonomic level detectable with genetic techniques (O'Toole 1999). In addition, microbial biodiversity is a community level property, which can influence functional stability (Naeem 1997), plant diversity and productivity (Bardgett et al. 2008), and potentially constrain a wide range of ecosystem functions. We also anticipate that we will identify further candidate properties to pursue as a result of our early interactions as a working group.

III. Analysis of datasets

The uniqueness of the proposed work lies in the novel synthesis of multiple datasets, the integration of general principles across aquatic and terrestrial ecosystems, and the (potentially predictive) power than can develop through elucidating relationships among microbial properties and ecosystem processes. To reach this goal, we propose to use a relatively simple statistical approach that can be consistently applied to the microbial

Microbial Property	Data	Manager	Source	Description
D1. Metagenomic Properties	Metagenomic Sequences	Jansson	Earth Microbiome Project, Terragenome (Cole et al. 2010), MiMARKS metadata standards (Yilmaz et al. 2011)	200,000 metagenomes from diverse ecosystems and climatological and environmental metadata
D2. Community Composition (PLFA)	Phospholipid Fatty Acid Profiles	Waldrop	USGS Geochemical Landscapes Project (http://minerals.cr.usgs.gov/projects/geochemical_landscapes/)	Characterization of soil geochemistry, microbial communities in soil samples from 10,000 sites
D3. Microbial Stoichiometry	Biomass Stoichiometric Ratios	Cotner and Hall	Cotner et al. (2011) and Hall et al. (2009) and other	Bacterial C:N:P ratios, metabolic rates, biogeochemical fluxes, and environmental variables from > 100 aquatic ecosystems
D4. Microbial Community Dormancy	Vital Stains, Metagenomic Sequences	Lennon, Jones and Hall	Lennon and Jones 2011 and unpublished	Surveys from a wide range of ecosystems (Lennon and Jones 2011), Lake dataset (described above) with % of bacterial community that is active

Table 1 – Describes the datasets discussed in the text to address the role of each candidate microbial community property in ecosystem function. We also anticipate the synthesis of additional data beyond what is identified here

parameters that we hypothesize constrain function. We will use Maximum Likelihood Analysis to evaluate whether models that include microbial metrics improve our ability to predict ecosystem function. We will rank the competing models using Akaike Information Criteria (AIC), which evaluates models based on explanatory power but also includes a penalty for additional parameters (Burnham and Anderson, 2002). Other studies have successfully used this approach to test whether microbial community properties explain

additional variability in biogeochemical rates (Wang et al. 2011). This approach will not only allow us to determine which microbial indicators are most important to measure, and when, but also produce estimates describing the relationship of these indicators to ecosystem functions, which could be used to test whether the incorporation of microbial dynamics can reduce error in process rates in more complex models (Lawrence et al. 2009, Todd-Brown et al. 2011).

IV. Personnel/ Expertise

To address these questions, we have assembled a team with expertise that covers a range of breadth from microbial to ecosystem ecology. This includes scientists with experience in terrestrial and aquatic systems, and at different career stages (**Table 2**).

Member	Affiliation	Field	Expertise
*Ed Hall	USGS/CSU (RB/RS I)	Microbial and Ecosystem Ecology (aq.)	Microbial Stoichiometry & Adaptation
*Jay Lennon	MSU (Asst. Professor)	Microbial and Ecosystem Ecology (aq/terr.)	Microbial Dormancy * Nutrient Cycling
*Matt Wallenstein	CSU (Asst. Professor)	Microbial and Ecosystem Ecology (terr.)	Thermal Adaptation Arctic Ecosystems
Emily Bernhardt	DU (Assoc. Professor)	Ecosystem Ecology and Biogeochemistry (aq./terr.)	Nutrient Cycling at the Aq./Terr. Interface
Claudia Boot	CSU (RS I)	Microbial Physiology and Env. Chemistry (terr.)	Ecological Applications of Analytical Chemistry
Mark Bradford	YU (Asst. Professor)	Community & Ecosystem Ecology (terr.)	Global Change Ecology
Jim Cotner	UMN (Professor)	Microbial Ecology and Biogeochemistry (aq.)	Microbial Stoichiometry Nutrient Cycling
Sarah Evans	CSU (Ph.D. Candidate)	Microbial and Ecosystem Ecology (terr.)	Microbial Adaptation to Soil Moisture
Janet Jansson	LBNL (Senior Staff Scientist)	Environmental Microbiology (terr.)	Environmental Metagenomics Microbial Genomics
Stuart Jones	ND (Asst. Professor)	Microbial and Ecosystem Ecology (aq.)	Microbial Diversity and Biogeography
Josh Schimel	UCSB (Professor)	Microbial and Ecosystem Ecology (terr.)	Plant and Microbial Linkages
Mark Waldrop	USGS (Ecosystem Microbial Ecologist)	Microbial Ecology and Biogeochemistry (terr.)	Microbial Carbon Cycling

Table 2– Abbreviations for affiliations are as follows: USGS - United States Geological Survey, CSU – Colorado State University, DU – Duke University, MSU – Michigan State University, ND – University of Notre Dame, LBNL – Lawrence Berkeley National Laboratory, UCSB – University of California Santa Barbara, UMN – University of Minnesota YU – Yale University. Abbreviations for positions are as follows: RB – Research Biologist, RS I – Research Scientist I. Field abbreviations are as follows: Aq. - Aquatic, Terr. – Terrestrial (* indicates project PI)

Notably this proposal was written with significant input from Sarah Evans, currently a senior Ph.D. student in the Wallenstein Lab, who would participate in the working group as a post-doc and be responsible for much of the synthesis and coordination of the project.

While the team has a breadth of expertise, there is also significant overlap in many of our research areas, which will facilitate communication and interactions between group members. In addition, while we have not all worked together before, and never all at once toward a coordinated goal, multiple members of this working group have previously conducted successful collaborative research to varying degrees that we think will facilitate our interactions and create a successful Powell Center working group. While there are previous and ongoing collaborations between group members, without Powell Center Support this group would not have the time or opportunity to address these pressing issues at the confluence of microbial and ecosystem ecology.

V. Timeline for activities

We propose to conduct the above activities over a period of ~ 2years. Specific goals and a timeline to achieve these goals are describes below.

February – June 2012:	Gather published datasets, standardize and format existing datasets over email, compile and circulate list of data to be provided at first meeting
July 2012	***First meeting:*** bring all datasets together, identify gaps in existing data and suggest new datasets to pursue. Discuss approach to problem, plan for analysis, divide and assign tasks for analysis. Outline initial concept paper and assign writing
July – Dec. 2012	Analysis of datasets organized by microbial community property in subgroups, write concept paper, coordinate by email
February 2013	***Second meeting:*** present results from initial dataset analyses, finalize concept paper for submission, outline smaller papers and assign writing, discuss additional analyses needed and novel ways forward
January – May 2013	Perform additional analyses, write focused papers, contextualize and interpret results
June 2013	***Third meeting:*** finalize focused manuscripts for submission, synthesize data for all microbial properties, outline synthesis manuscript and assign writing, begin proposal for future research
January 2014	***Fourth meeting*** *(if necessary)**:*** finalize synthesis manuscript for publication, wrap up and synthesis of proposed research, define new way forward

VI. Anticipated outcomes

During the course of our working group we expect to generate a series of publications and a proposal to submit for funding of future research related to the ideas discussed above.

a) In the earliest stages we anticipate a conceptual paper that expands on many of the ideas presented here and synthesizes our current knowledge of microbial linkages to ecosystem function with a discussion for how these results can be incorporated into ecological forecasting and monitoring. Depending on the final scope of the manuscript this may be suitable for publication in *Ecosystems, Ecological Applications* or similar.

b) Towards the later half of the project duration we anticipate the publication of a series of smaller and more focused manuscripts that test the ability of various microbial community properties (those described here and others we will identify after the initial meeting) as indicators of ecosystem function.

c) Towards the end of the working group we anticipate a final synthesis manuscript directed towards a broad readership in high-impact journal (*Nature, Science, PNAS)*. This synthesis will simultaneously evaluate multiple microbial community properties as indicators of ecosystem processes and direct future research and sampling efforts to most effectively address how microbial analyses can inform us about potential impacts of global change.

d) Finally, the exercises outlined here will allow us to clearly define what is known. Just as important, it will clearly provide insight into what is needed to fully incorporate microbial properties into ecosystem level models. From the initial meeting on, we will consider not only what data is available, but what data is required to really achieve the goal of proposed work (identification of the next generation of ecological indicators). The interactions provided by our Powell Center activities will allow us to identify shortcomings in extant datasets, and prepare a proposal to conduct future research to generate new data that best fills the limitations of what is available.

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Edward K. Hall

Natural Resource Ecology Laboratory/
U. S. Geological Survey/ Colorado State University
Campus Delivery 1499
Fort Collins CO 80523-1499
Tel: 970-491-2153
email: ed.hall@colostate.edu

EDUCATION

MBL Microbial Diversity Course	(2010)	
University of Minnesota, Twin Cities	(2006)	Ph.D. Ecology
University of Massachusetts, Amherst	(1997)	B.S. Biology

PROFESSIONAL APPOINTMENTS

Fall 2011	Colorado State. Univ. (NREL) Research Scientist I
Spring 2011	USGS Mendenhall Fellow
2007 – 2010	Department of Limnology, University of Vienna, Post-Doctoral Fellow

SELECTED GRANTS, FELLOWSHIPS & AWARDS

Gene E. Likens Award, ESA Biogeosciences	August 2011	$250
USGS Mendenhall Fellowship	June 2010	~$200,000
Center for Water Sciences, Michigan State University (Co- PI with Jay Lennon)	June 2007	$30,000

REPRESENTATIVE PUBLICATIONS

Wallenstein, M. and Hall, E.K. A trait-based framework for predicting when and where microbial adaptation to climate change will affect ecosystem function. Biogeochemistry DOI 10.1007/s10533-011-9641-8

Cotner, J.B. and Hall, E.K. 2011 Comment on "A bacterium that can grow by using arsenic instead of phosphorus" Science 332: 1149

Hall, EK, Maixner F, Franklin O, Daims H, Richter A & Battin T 2011 Linking microbial and ecosystem ecology using ecological stoichiometry: concepts and empiricism. Ecosystems 14(2): 261-273 *Gene Likens Award (ESA)*

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Keiblinger, K.M.† Hall, E.K†, Szukics, U., Hämmerle, I., Ellersdorfer, G., Sterflinger, K., Wanek, W., Richter, A., Jandl R., and Zechmeister-Boltenstern, S. 2010 The effect of resource quantity and resource stoichiometry on microbial carbon use efficiency FEMS Microbiology Ecology 73(3): 430-440 († these authors contributed equally to this work)

Hall, E.K., Singer, G. A., Kainz, M.J. and Lennon, J. T. 2010 Evidence for a temperature acclimation mechanism in freshwater bacteria: an empirical test of a hypothesized membrane mediated trade-off. Functional Ecology 24 (4): 898-908

Hall, E.K., Dzialowski, A.R., Stoxen, S.M.*, and Cotner, J.B. 2009 The effect of temperature on the coupling between phosphorus and growth in lacustrine bacterioplankton communities Limnology and Oceanography 54: 880-889

Hall, E. K., Neuhauser, C. and Cotner J.B. 2008 Towards a mechanistic framework of how temperature affects natural bacterial communities The ISME Journal 2 (4): 1-11

Hall, E.K. and Cotner, J.B. 2007 The interactive effect of temperature and resources on carbon cycling by bacterioplankton communities Aquatic Microbial Ecology 49: 35-45

PROFESSIONAL SERVICE/MEMBERSHIPS Frontiers in Aquatic Microbiology (Review Editor), Ecological Society of America (ESA) Member, International Society of Microbial Ecology (ISME) Member, Advancing the Science of Limnology and Oceanography (ASLO) Member, Chair and Organizer of Special Session (#04) ASLO 2004 Savannah, GA USA **Reviewer:** U.S. National Science Foundation, Ecology Letters, Ecosystems, Environmental Microbiology, Aquatic Microbial Ecology, Microbial Ecology, Hydrobiologia, Journal of Plankton Research, Research in Microbiology, Biogeochemistry, Journal for Himalayan Science (!)

JAY-TERRENCE LENNON
W.K. Kellogg Biological Station and Department of Microbiology & Molecular Genetics
Michigan State University, 3700 East Gull Lake Drive, Hickory Corners, MI 49060
Phone: (269) 671-2340; FAX: (269) 863-2104
lennonja@msu.edu, www.microbes.kbs.msu.edu

EDUCATION:

Dartmouth College	Ph.D.	2004	Ecology & Evolutionary Biology
University of Kansas	MA	1999	Ecology & Evolutionary Biology
SUNY-ESF at Syracuse	BS	1995	Environmental Forest Biology

PROFESSIONAL EXPERIENCE:

2006-current	Assistant Professor, Kellogg Biological Station and the Department of Microbiology & Molecular Genetics, Michigan State University
2009-current	Adjunct Professor, Department of Plant Biology, Michigan State University
2004-2006	Postdoctoral Research Associate, Brown University, Department of Ecology & Evolutionary Biology

MOST RELEVANT PUBLICATIONS:

Lennon JT, Aanderud ZA, Lehmkuhl BK, Schoolmaster DR. Mapping the niche space of soil microorganisms using taxonomy and traits. In Revision.

Tresder KK, Balser TC, Bradford MA, Brodie EL, Eviner VT, Hofmockel KS, Lennon JT, Levine UY, MacGregor BJ, Pett-Ridge J, Waldrop MP. Integrating microbial ecology into ecosystem models. Biogeochemistry DOI 10.1007/s10533-011-9636-5

Lennon JT, Jones SE (2011) Microbial seed banks: ecological and evolutionary implications of dormancy. Nature Reviews Microbiology 9:119-130

Fierer N, Lennon JT (2011) The generation and maintenance of diversity in microbial communities. American Journal of Botany 98: 439-448.

Lau JA, Lennon JT (2011) Evolutionary ecology of plant-microbe interactions: soil microbial structure alters natural selection on plant traits. New Phytologist. 192:215-224

Aanderud ZT, Lennon JT (2011) Validation of heavy-water stable isotope probing for the characterization of rapidly responding soil bacteria. Applied and Environmental Microbiology 77: 4589-4596

Aanderud ZT, Schoolmaster DR, Lennon JT (2011) Plants mediate the sensitivity of soil respiration to rainfall variability. Ecosystems. 14: 156-167.

SE Jones, Lennon JT (2010) Dormancy contributes to the maintenance of microbial diversity. Proceedings of the National Academy of Sciences of the United States of America. 107: 5881-5886

Hall EK, Singer GA, Kainz MJ, Lennon JT (2010) Evidence for temperature acclimation in bacteria: an empirical test of a hypothesized membrane-mediated trade-off. Functional Ecology 24: 898-908

Jones SE, Lennon JT (2009) Evidence for limited microbial transfer of methane in a planktonic food web. Aquatic Microbial Ecology 58: 45-53

Lennon JT, Martiny JBH. (2008) Rapid evolution buffers ecosystem impacts of viruses in a microbial food web. Ecology Letters. 11: 1178-1188.

Lennon JT, Cottingham KL (2008) Microbial productivity in variable resource environments. Ecology 89: 1001-1014.

SYNERGISTIC ACTIVITIES:

2008-2011	Microbial Ecology Section, ESA, Secretary, Vice Chair, and Chair
2009-2011	Co-Director, Microbial Metagenomics, advanced summer course offered with Dr. Tom Schmidt at the Kellogg Biological Station
2010	Special session co-organizer: Micro-Managing the Planet: The Role of Microbial Ecology in Planetary Stewardship. ESA, Pittsburgh, PA
2010	A synthesis of the importance of allochthonous and autochthonous support of consumers in aquatic ecosystems, ASLO, Santa Fe, New Mexico
2009	Scientific Committee on Oceanographic Research (SCOR), Role of Viruses in Marine Ecosystems, Newark, Delaware
2009	Plant Virus Ecology Network (PVEN), Venice, Italy
2008	SoilCritZone Workshop, Early Stage Researcher (ESR), Chania, Crete, Greece
2008	DOE Joint Genome Institute (JGI), Microbial Genomics & Metagenomics Workshop
2007	LTER Genomics Workshop, Catalyzing Cross-Site Comparisons of Microbial Diversity and Function
2007	DOE Joint Genome Institute (JGI) Undergraduate Research Program in Microbial Genome Annotation
2007	Invited participant: Microscale Approaches to Macroscale Issues in Ecology, Washington, DC
2006-2010	Executive Board Member, Biogeochemistry Environmental Research Initiative (BERI), Michigan State University
2006-2011	NSF review panels: Ecosystems; Doctoral Dissertation Improvement Grants (DDIG). USDA review panel: Understanding Plant Associated Miroorganisms

TEACHING AND TRAINING ACTIVITIES

Postdoctoral advisees: Stuart Jones, Zachary Aanderud, Ed Hall, Evan Kane, Sarah Placella, Ariane Peralta

Graduate advisees: Kali Bird, Megan Larsen, and Mario Muscarella

Courses taught: Biogeochemistry (MMG 426, summer field course at KBS), Microbial Ecology (MMG 425, upper-level lecture course in E. Lansing), Microbial Metagenomics (summer course at KBS)

ADVISORS

Val Smith (Master's), Kathy Cottingham (Ph.D.), Jen Martiny (Postdoc)

PROFESSIONAL SOCIETY MEMBERSHIP:

Ecological Society of America (ESA)

American Society of Limnology and Oceanography (ASLO)

American Society of Microbiology (ASM)

MATTHEW D. WALLENSTEIN
Colorado State University
Natural Resource Ecology Laboratory
Fort Collins, CO 80523-1499
Phone: 970/556-2591; Fax 970/491-1965; E-mail: matthew.wallenstein@colostate.edu

(i) Professional Preparation

Franklin and Marshall College	Geosciences	BA, 1996
Duke University	Ecology	Ph.D., 2004
Univ of California, Santa Barbara	NSF Postdoctoral Fellow	2004-2007

(ii) Appointments

2010-present	Dept of Ecosystem Science and Sustainability	Assistant Professor
2007-present	Natural Resource Ecology Lab, CSU	Research Scientist II
2007-present	Graduate Degree Program in Ecology, CSU	Faculty

(iiia) Publications (5 most relevant)

Allison SD, Wallenstein MD, & Bradford MA. 2010. Soil-carbon response to warming dependent on microbial physiology. Nature Geosci 3:336-340.

McMahon, S., M. Wallenstein, and J. Schimel. 2009. Microbial growth in Arctic tundra soils at -2 °C. *Environmental Microbiology Reports* 1:162-166.

McMahon, Shawna K., Matthew D. Wallenstein, and Joshua P. Schimel. 2010. A cross-seasonal comparison of active and total bacterial community composition in Arctic tundra soil using bromodeoxyuridine labeling. Soil Biology & Biochemistry 43:287-295.

Wallenstein, M. D., McMahon, S. K., Schimel, J. P., 2009. Seasonal variation in enzyme activities and temperature sensitivities in Arctic tundra soils. Global Change Biology 15, 1631-1639.

Wallenstein, M.D., S. McMahon, and J. Schimel. 2007. Bacterial and fungal community structure in arctic tundra tussock and shrub soils. FEMS Microbiology Ecology. 59:428-435.

(iiib) Publications (5 representative)

Bradford, M. C. A. Davies, S. D. Frey, T. R. Maddox, J. M. Melillo, J. E. Mohan, J. F. Reynolds, K. K. Treseder & M. D. Wallenstein. 2008. Acclimation of soil microbial respiration to elevated temperature. Ecology Letters 11:1316-1327.

Conant, R., M. Ryan, G. Ågren, H. Birge, E. Davidson, P. Eliasson, S. Evans, S. Frey, C. Giardina, F. Hopkins, R. Hyvönen, M. Kirschbaum, J. Lavallee, J. Leifeld, W. Parton, J.M. Steinweg, M. Wallenstein, J. A. Wetterstedt, and M. Bradford. 2011. Temperature and soil carbon decomposition – synthesis of current knowledge and a way forward. Global Change Biology. DOI: 10.1111/j.1365-2486.2011.02496.x

Schimel, J., T.C. Balser, and M.D. Wallenstein. 2007. Stress Effects on Microbial Communities and the Implications for Ecosystem Function. Ecology 88:1386-1394.

Wallenstein M, Hall E. 2011. A trait-based framework for predicting when and where microbial adaptation to climate change will affect ecosystem functioning. Biogeochemistry DOI: 10.1007/s10533-011-9641-8.

Wallenstein, M.D. and M. Weintraub. 2008. Emerging approaches for measuring and modeling in situ soil enzyme activities. Soil Biology & Biochemistry 40:2098-2106.

(iv) Synergistic Activities (5 representative)

1. Editorships: Associate Editor for *Biogeochemistry*, 2009-present; Subject Editor for *Soil Biology & Biochemistry*, 2009- present; Editorial Advisory Board for *Global Change Biology*. 2008-present; Review Editor for *Trends in Terrestrial Microbiology*. 2010-present.
2. Director, Enzymes in the Environment Research Coordination Network, 2009-present
3. Chair, The First International Symposium on Environmental Proteomics, Jan 2010
4. Secretary, Ecological Society of America, Biogeosciences Section, 2008-2009
5. Guidance Committee, American Geophysical Union, Biogeosciences Section, 2009-present

(v) Collaborators & Other Affiliations

Collaborators

Steven Allison (UC-Irvine), Ed Ayres (NEON), Emily Bernhardt (Duke), Thomas Borch (CSU), Mark Bradford (Yale), Eoin Brodie (LBNL), Rich Conant (CSU), Francesca Cotrufo (CSU), Feike Djikstra (USDA), Jeff Dukes (UMass), Noah Fierer (CU), Adrien Finzi (BU), Shawna McMahon (CSU), John Moore (CSU), Jack Morgan (USDA), Eldor Paul (CSU), Elise Pendall (UWyoming), Kenneth Reardon (CSU), Josh Schimel (UC Santa Barbara), Heidi Steltzer (FLC), Michael Weintraub (U Toledo).

Thesis Advisors and Postgraduate Fellowship Sponsor

B.A. Andrew Barton (Franklin and Marshall College, now University of Maine)
Ph.D. William H. Schlesinger (Duke University, now Institute for Ecosystem Studies)
Doctoral Committee: James Clark (Duke), Steven McNulty (USDA), Daniel Richter (Duke), Rytas Vilgalys (Duke)
Postdoctoral: Joshua Schimel (University of California)

Advisees (8 total)

Jessica Ernakovich (PhD, NSF and DOE Graduate Fellow), Sarah Evans (PhD, NSF Graduate Fellow), J. Megan Steinweg (PhD awarded 2011), Caroline Melle (MS in progress), Barbara Fricks (NSF IGERT Fellow, PhD in progress), Jennifer Rocca (PhD)

Shawna McMahon (Postdoctoral Associate 2009-2011), Claudia Boot (NSF Postdoctoral Fellow), Colin Bell (Postdoctoral Associate), Akihiro Koyama (Postdoctoral Associate)

EMILY SNOW BERNHARDT

Associate Professor, Department of Biology,
French Family Science Bldg. 3313, Box 90338, Duke University, Durham, NC 27708
Telephone (919)660-7318; Fax (919) 660-7293; e-mail: ebernhar@duke.edu

Professional Preparation

UNC Chapel Hill	Biology	B.S., 1996
Cornell University	Ecology and Evolutionary Biology	Ph.D., 2001

Professional Experience

2010-Present	Associate Professor, Department of Biology, Duke University
2004-2010	Assistant Professor, Department of Biology, Duke University
2005-Present	Secondary Appointment, Nicholas School of the Environment, Duke University
2002-2004	Post-doctoral Research Associate, University of Maryland
2001-2002	Post-doctoral Research Associate, Duke University

Awards

Langford Lecturer, Duke University 2010
Duke University Postdoctoral Association Outstanding Postdoctoral Mentor Award 2008
Career Award, National Science Foundation 2005
H.G. Hynes Award for new investigators, North American Benthological Society 2003
Wildco Award, North American Benthological Society 2001
NSF Graduate Fellowship 1996-2000

10 Representative, Relevant Publications (underline = member of Bernhardt lab):

Colman, B.P., M. Auffan, Liu, J., M. Wiesner and **E.S. Bernhardt**. *In Review.* Engineered silver nanoparticle impacts on microbial processes and community composition in streamwater and sediments. Environmental Toxicology

Lindberg. T.T., **E.S. Bernhardt**, R. Bier, A. Helton, R. Merola, A.Vengosh, R.T. Di Giulio. *In Press.* Cumulative impacts of mountaintop mining on an Appalachian watershed. Proceedings of the National Academy of Sciences

Morse, J.L., M. Ardón and **E.S. Bernhardt**. *In Press.* Greenhouse gas fluxes in coastal plain wetlands under contrasting land uses. Ecological Applications

Lutz, B.J., **E.S. Bernhardt**, P.J. Mulholland, B.R. Roberts and R. M. Cory. 2012. Distinguishing terrestrial and autochthonous organic matter dynamics in a forested stream using kinetic enrichments and fluorescence spectroscopy. Limnology and Oceanography 57: 76-89.

Wang, S., **E.S. Bernhardt**, J.P. Wright, M. Wallenstein and E.B. Sudduth. 2011. Watershed urbanization alters the composition and function of stream bacterial communities. PLOS-One 6

Sudduth, E.B., B.A. Hassett, P. Cada and **E.S. Bernhardt**. 2011. Testing the Field of Dreams Hypothesis: Functional Responses to Urbanization and Restoration in Stream Ecosystems. Ecological Applications 21: 1972-1988

Lutz, B.D., **E.S. Bernhardt**, B.R. Roberts and P.J. Mulholland. 2011. Controls on organic nitrogen losses from temperate forests with elevated N loading: implications for biogeochemical theory. Ecology 92: 720-732

Phillips, R.P., **E.S. Bernhardt** and A.C. Finzi. 2011. Enhanced root exudation induces microbial feedbacks to N cycling in a pine forest under long-term CO_2 fumigation. Ecology Letters 14: 187-194.

Fierer, N., J.L. Morse, S. Berthrong, **E.S. Bernhardt**, R.B. Jackson. 2007. The landscape-level biogeography of stream bacterial communities. Ecology 88: 2162-2173

E.S. Bernhardt, G.E. Likens, R.O. Hall, Jr., D.C. Buso, S.G. Fisher, T.M. Burton, J.L. Meyer, W.H. McDowell, M.S. Mayer, W.B. Bowden, S.E.G. Findlay, K.H. Macneale, R.S. Stelzer, W.H. Lowe. 2005. Can't See the Forest for the Stream? The capacity of instream processing to modify terrestrial nitrogen exports. BioScience 52:219-230.

Synergistic Activities & Professional Service

Duke University Program in Ecology Director of Graduate Studies (2011-2013); National Academy Panel member, Committee for the Advancement of Hydrologic Sciences (2010-2012); Associate Editor, JGR Biogeosciences (2010-present); Board Member, Environmental Defense NC (2009-present); Ecological Society of America Ecological Visions Committee (2003); Publications Committee (2003-2010), Secretary, Biogeosciences Section (2006-2007); North American Benthological Society Executive Committee (2003-2005); JNABS evaluation committee (2006-2008); Coordinator of the National River Restoration Science Synthesis Project 2002-2005

Advisors and Collaborators

Advisors: *Graduate:* G.E. Likens (IES), B.L. Peckarsky (Cornell); *Postdoctoral:* W.H. Schlesinger (Duke U.), M.A. Palmer (U MD)

Current Advisees: *PhD students***:** Matt Ross, 2011-present; Kris Voss, 2011-present; Raven Bier, 2010-present; Kayleigh Somers, 2009-present; Alison Appling, 2006-present; *Postdoctoral Associates*: Benjamin Colman, 2009-present; Ashley Helton, 2011-present; Brian Lutz, 2011-present; *Professional Masters Students: Joseph Riegel,* 2011

Major Collaborators, last 48 months: L.E. Band, (UNC), P. Bertsch (UKY), A. Burgin (Wright State), M.W. Doyle (UNC), A. Finzi (BU), J. Grace (USGS), C. Gunsch (Duke), J. Heffernan (FIU), M. Hochella (Virginia Tech), R. Jackson (Duke), R. King (Baylor U.), G. Lowry (Carnegie-Mellon), W.H. McDowell (UNH), J.L. Meyer (UGA), J.L. Morse (Cary IES), P.J. Mulholland (ORNL), M.A. Palmer (UMD), M.J. Paul (Tetra Tech), S.A. Perakis (USGS), R. Phillips (U IN), G. Poole (MT State), C. Richardson (Duke), B.J. Roberts (LUMCON), J.A. Stanford (UMT FLBS), E.B. Sudduth (GA Gwinnet), D. Urban (Duke), M. Wallenstein (CSU), M. Wiesner (Duke), J.P. Wright (Duke)

Mark A. Bradford – Biographical Sketch

School of Forestry and Environmental Studies, Yale University, New Haven, CT 06511, USA

A. Professional Preparation

Undergraduate: University of Exeter (UK); Biological Sciences; B.Sc. (Hons.) 1995
Postgraduate: Institute of Terrestrial Ecology (Merlewood, UK) & University of Exeter (UK); Ecology; Ph.D. 1999
Postdoctoral: NERC Centre for Population Biology, Imperial College (UK); Postdoctoral Research Associate (PDRA) in Community & Ecosystem Ecology; 1999-2000
NERC Centre for Population Biology, Imperial College (UK); Ecotron Project Leader and PDRA in Community & Ecosystem Ecology; 2000-2002
Dept. of Biology, Duke University; PDRA in Ecology and Global Change; 2002-2004

B. Appointments

Jan '09-present – Assistant Prof., Yale School of Forestry & Environmental Studies
Jan '09-present – Adjunct Prof., Odum School of Ecology, Univ. of Georgia, Athens
Jan '05-Dec '08 – Assistant Prof., Odum School of Ecology, Univ. of Georgia, Athens

C. Ten publications most closely related to the proposal

Allison, S.D., Wallenstein, M.D., **Bradford, M.A.** (2010) Soil carbon response to warming is dependent on microbial physiology. *Nature Geoscience*, **3**, 336-340.

Bradford, M.A., Fierer, N. The biogeography of microbial communities and ecosystem processes: Implications for soil and ecosystem models. (in press for 2012) *In* Wall, D.H., Bardgett, R.D., Behan-Pelletier, V., Herrick, J.E., Jones, H., Ritz, K., Six, J., Strong, D.R., and van der Putten, W.H. (eds.) *Soil Ecology and Ecosystem Services*. Oxford University Press, UK (Invited)

Bradford, M.A., Watts, B.W., Davies, C.A. (2010) Thermal adaptation of heterotrophic soil respiration in laboratory microcosms. *Global Change Biology*, **16**, 1576-1588

Bradford, M.A., Davies, C.A., Frey, S.D., Maddox, T.R., Melillo, J.M., Mohan, J.E., Reynolds, J.F., Treseder, K.K., Wallenstein, M.D. (2008) Thermal adaptation of soil microbial respiration to elevated temperature. *Ecology Letters*, **11**, 1316-1327.

Conant, R.T., Ryan, M.G. Ågren, G.I., Birge, H.E., Davidson, E.A., Eliasson, P.E., Evans, S.E. Frey, S.D., Giardina, C.P., Hopkins, F., Hyvönen, R., Kirschbaum, M.U.F., Lavallee, J.M., Leifeld, J., Parton, W.J., Steinweg, J.M., Wallenstein, M.D., Wetterstedt, J.Å.M., **Bradford, M.A.** (2011) Temperature and soil organic matter decomposition rates – synthesis of current knowledge and a way forward. *Global Change Biology*, **17**, 3392-3404

Fierer, N., Lauber, C.L., Ramirez, K.S., Zaneveld, J., **Bradford, M.A.**, Knight R. (in press) Comparative metagenomic, phylogenetic, and physiological analyses of soil microbial communities across nitrogen gradients. *ISME Journal*.

Fierer, N., **Bradford, M.A.**, Jackson R.B. (2007) Toward an ecological classification of soil bacteria. *Ecology* **88**, 1354-1364 (Special Feature Article – New Directions in Microbial Ecology).

Keiser, A.D., Strickland, M.S., Fierer, N., **Bradford, M.A.** (2011) The effect of resource history on the functioning of soil microbial communities is maintained across time. *Biogeosciences*, **8**, 1477-1486 (Part of Special Feature – Biotic interactions and biogeochemical processes in the soil environment).

Strickland, M.S., Lauber, C., Fierer, N., **Bradford, M.A.** (2009) Testing the functional significance of microbial community composition. *Ecology*, **90**, 441-451.

Treseder, K.K., Balser, T.C., **Bradford, M.A.**, Brodie, E.L., Dubinsky, V.T., Eviner, V.T., Hofmockel, K.S., Lennon, J. T., Levine, U.Y., MacGregor, B.J., Pett-Ridge, J., Waldrop, M.P. (2011) Integrating microbial ecology into ecosystem models: challenges and priorities. *Biogeochemistry*. DOI: 10.1007/s10533-011-9636-5

D. SYNERGISTIC ACTIVITIES

- Editorial board member of the British Ecological Society's *Ecological Reviews*
- Advisory Editorial member for *Global Change Biology*
- Frequent reviewer for journals: *Applied Soil Ecology, Biogeochemistry, Biogeosciences, Ecology, Ecology Letters, Ecosystems, Functional Ecology, Global Change Biology, Journal of Ecology, Nature Climate Change, New Phytologist, Oecologia, Oikos, Plant and Soil, Science, Soil Biology & Biochemistry*
- Reviewer for funding agencies: *National Science Foundation*

E. COLLABORATORS AND OTHER AFFILIATIONS

Collaborators and co-editors (past 48 months): Allison, Steve (Irvine), Bahn, Volker (Wright State); Brodie, Eoin (Lawrence Berkeley); Callaham, Mac (USFS); Carrillo, Yolima (Wyoming); Conant, Rich (CSU); Fierer, Noah (UC Boulder); Flory, Luke (Indiana); Fraterrigo, Jen (Illinois); Frey, Serita (UNH); Grandy, Stuart (MSU); Knoepp, Jennifer (USFS); Maerz, John (UGA); McCulley, Rebecca (Kentucky); Rich Phillips (Indiana); Treseder, Kathleen (Irvine); Wall, Diana (Colorado St.); Wallenstein, Matt (Colorado St.)

Graduate and postdoc advisors: Graduate: Phil Ineson (York Univ., UK), Hilary M. Lappin-Scott (Univ. of Exeter, UK), Phil A. Wookey (Univ. of Stirling, UK); Postdoctoral: T. Hefin Jones (Cardiff Univ., UK), John H. Lawton (retired), James F. Reynolds (Duke Univ.)

Thesis advisor and postgraduate scholar-sponsor: Postdoctoral advisor for: Christian Davies (completed); Mike Strickland (Yale); Robert Warren (Yale). Postgraduate advisor for: Becky Ball (graduated); Catherine Fontana (Yale); Ashley Keiser (Yale); Tim Kramer (graduated); Ken Leonard (graduated); Caitlin O'Brady (graduated); Bhavya Sridhar (Yale); Emily Stevenson (graduated); Mike Strickland (graduated); Yaya Tang (graduated); Tara Ursell (Yale); Stephen Wood (graduated). Undergraduate thesis advisor for: Tara Gancos (graduated); Taylor Gregoire-Wright (Yale); Calley Mersman (graduated); Ernie Osburn (graduated); Henry Schumacher (graduated); Victoria Smith (graduated); Brian Watts (UGA)

CLAUDIA MICHAELA BOOT

Research Scientist I/NSF Postdoctoral Fellow
Natural Resource Ecology Laboratory
Colorado State University, Fort Collins, CO 80525
office: 970-491-2162 fax: 970-491-1965 e: claudia.boot@colostate.edu

1. PROFESSIONAL PREPARATION

University of Puget Sound, Tacoma, WA	Biology	1995-1997
University of Colorado, Boulder, CO	Biology	B.A. 1999
University of California, Santa Cruz, CA	Ocean Science	Ph.D. 2007
University of California, Santa Barbara, CA	Soil Microbial Ecology	2007 – 2009
Colorado State University, Fort Collins, CO	Soil Microbial Ecology	2009 – present

2. APPOINTMENTS

09/2010 – present *Research Scientist I, NREL*, *Colorado State University*, Fort Collins, CO
07/2009 – present *Postdoctoral Fellow, NSF Office of Polar Programs*
Colorado State University, Fort Collins, CO
University of California, Santa Barbara, CA
Characterization of dissolved organic matter from arctic ecosystems using LCMS and fluorescence spectroscopy. Study of dry season processes: metabolic and microbial community response of dry soils to rewetting events; source of carbon in rewetting pulse.

09/2007 – 06/2009 *Postdoctoral Scholar, University of California, S*anta Barbara, CA
Characterization of the physiological response of microbes to stress (drought and freezing). Chemical identification and quantification of microbial metabolites including amino acids and sugar alcohols in CA grasslands, Santa Cruz Island, and Alaskan arctic.

06/2002 – 08/2007 *Marine Bioorganic Chemist, University of California*, Santa Cruz, CA
Discovery and structure elucidation of novel anti-cancer biomolecules
Research in organic analytical chemistry including purification of fungal secondary metabolites with HPLC, analysis via mass spectroscopy, 1D and 2D NMR. Additional experience in environmental DNA extraction, PCR, and other molecular techniques.

3. PUBLICATIONS

Boot, CM, SM Schaeffer, JP Schimel. In prep. No change in microbial osmolyte pools in response to seasonal drought. *Soil Biology and Biochemistry*.

Boot, CM, SM Schaeffer, MS Carbone, CJ Still, JP Schimel. In prep. Dynamic response of forest litter and mineral soil microbes to pulsed water additions. *Soil Biology and Biochemistry*

Boot, CM. *Microbial response to drying and rewetting: osmotic and matric effects*. 2011. *Plant and Soil*. 348:99-102. DOI 10.1007/s11104-011-0958-9

Carbone, MS, CJ Still, AM Ambrose, TE Dawson, AP Williams, **CM Boot**, SM Schaeffer, JP Schimel. 2011. Seasonal and episodic moisture controls on plant and microbial contributions to soil respiration. *Oecologia*. DOI 10.1007/s00442-011-1975-3.

Boot, **CM**, NC Gassner, JE Compton, K Tenney, CM Tamble, RS Lokey, TR Holman, P Crews. 2007. Pinpointing pseurotins from a marine-derived *Aspergillus fumigatus* as tools for chemical genetics using a synthetic lethality yeast screen. *Journal of Natural Products* 70:1672-1675.

Boot, **CM**, T Amagata, K Tenney, JE Compton, H Pietraszkiewicz, FA Valeriote, P Crews. 2007. Four classes of structurally unusual peptides from two marine-derived fungi. *Tetrahedron* 63:9903-9914.

Boot, **CM**, K Tenney; FA Valeriote, P Crews. 2006. Highly N-methylated linear peptides produced by an atypical *Acremonium* sp.. *Journal of Natural Products* 69:83-92.

4. SYNERGISTIC ACTIVITIES

1. Editorial Duties: Section Editor, *Plant and Soil* (Aug. 2010 – present); Reviewer for *Soil Biology and Biochemistry*, *Plant and Soil*, and *Journal of Natural Products*
2. K-12 Outreach: Designated Science Line Responder: Answer online questions for middle and high school students (Jan. 2009 – present), 'Soil Science' Talk for 8th grade field trip to University of California Sedgwick Reserve (Aug. 2009)
3. Undergraduate Outreach: Mentor to 4 female undergraduate researchers – Teryn Paul, current student; Janine Tom, graduate student in organic chemistry at UC Irvine; Alyssa Raley; and Amy Pan. 'How to Use Power Point' workshop for ACCESS (community college to university transitional program, summers, 2003 – 2007), Research talks at Cabrillo Community College, Aptos, CA, and Monterey Peninsula College, Monterey, CA; for ACCESS program (summers, 2002 – 2003) Volunteer Mentor, Minorities in Biomedical Research Program, UCSC (summers, 2001 – 2007)
4. Media/Press: Invitee to White House event announcing NSF's new family friendly policies (Sept. 2011), Press coverage at: http://www.today.colostate.edu/story.aspx?id=6483; 'American Geophysical Union Online Video Profile of Younger Scientists (July 2009)
5. University Service: Seminar Coordinator: New Voices in Ecology, Natural Resource Ecology Lab (Jan. 2011), Graduate Student Representative, Diving Control Board, UCSC (2002 – 2007),

5. RECENT FELLOWSHIPS/AWARDS

Postdoctoral Fellowship, 2009-2012, Office of Polar Programs, National Science Foundation ($239,000)
Warner College of Natural Resources Research Grant, 2011, Colorado State University ($10,000)
Dr. Earl and Ethyl Myers Oceanographic Trust Grant, 2007, University of California ($1,500)

7. RECENT CONFERENCES

Ecological Society of America
Austin, TX. August 8th-12th, 2011. Organized Oral Session Convener: *Microbial Responses to Moisture Availability: Scaling up from Physiology to Ecosystem-Level Processes*. Claudia M. Boot, Stephanie N. Kivlin, Bonnie G. Waring, Sean M. Schaeffer.

American Geophysical Union
San Francisco, CA. December 13th-17th, 2010. Oral Presentation: *Dynamic Response of Forest Litter and Mineral Soil to Pulsed Water Additions*. Claudia M. Boot, Sean M. Schaeffer, Mariah S. Carbone, Christopher J. Still and Joshua P. Schimel.

International Society for Microbial Ecology
Seattle, WA. August 23rd-27th, 2010. Poster Presentation: *What is the Physiological Response of Microbes to Drought?* Claudia M. Boot, Sean M. Schaeffer, Allen P. Doyle, Joshua P. Schimel.

Curriculum Vitae: James Bryan Cotner

Address:

Department of Ecology, Evolution and Behavior
University of Minnesota
St. Paul, MN 55108
Telephone: 612-625-1706/FAX: 612-624-6777 email: cotne002@umn.edu

Education:

B.A., Wittenberg University, Springfield, Ohio, 1981, Biology.
M.Sc., Kent State University, Kent, Ohio, 1984. Biology.
Ph.D., University of Michigan, Ann Arbor, 1990 Biology.
Post-doctoral research fellow, Great Lakes Environmental Research Laboratory and University of Michigan, Biological Limnology and Oceanography, 1990-1992.

Professional Experience:

2008 to present	Professor, Department of Ecology, Evolution and Behavior, University of Minnesota
2001 to 2008	Associate professor, Department of Ecology, Evolution and Behavior, University of Minnesota
1998 to 2001	Assistant professor, Department of Ecology, Evolution and Behavior, University of Minnesota
1992 to 1998	Assistant professor, Department of Wildlife and Fisheries Sciences and Department of Oceanography, Texas A&M University.

Publications (5 most relevant):

Cotner J.B., E.K. Hall, T. Scott and M. Heldal. 2010. Freshwater bacteria are stoichiometrically flexible with a nutrient composition similar to seston. Front. Microbio. doi: 10.3389/fmicb. 2010.00132

Stets, E.G., and J.B. Cotner. 2008. Littoral zones as sources of biodegradable dissolved organic carbon in lakes. Canadian Journal of Fisheries and Aquatic Science 65 :2454-2460.

Cotner, J.B., B A Biddanda, W Makino, and T Stets. 2004. Organic Carbon Biogeochemistry of Lake Superior. Aquatic Ecosystem Health and Management 7: 451-464.

Hall, E.K., C. Neuhauser and J.B. Cotner. 2008. Toward a mechanistic understanding of how natural bacterial communities respond to changes in temperature in aquatic ecosystems. ISME Journal 2: 471-481.

Tranvik, L.J., J.A. Downing, J.B. Cotner and others. 2009. Lakes and reservoirs as regulators of carbon cycling and climate. Limnology and Oceanography 54: 2298-2314.

Publications (5 others):

Stets, E.G., and J.B. Cotner. 2009. Littoral zones as sources of biodegradable dissolved organic carbon in lakes. Canadian Journal of Fisheries and Aquatic Science 65 :2454-2460.

Biddanda, B.A., and J.B. Cotner. 2002. Love handles in aquatic ecosystems: Role of dissolved organic carbon drawdown, resuspended sediments and terrigenous inputs in the carbon balance of a Great Lake (Michigan). Ecosystems 5: 431-445.

Cory, R.M., J.B. Cotner and K. McNeill. 2009. Quantifying interactions between singlet oxygen and aquatic fulvic acids. Environmental Science and Technology 43: 718-723.

Cotner, J.B., and B.A. Biddanda. 2002. Small players, large role: Microbial influence on auto-heterotrophic coupling and biogeochemical processes in aquatic ecosystems. Ecosystems 5, 105-121.

Cotner, J.B., W. Makino, B.A. Biddanda. 2006. Temperature affects stoichiometry and biochemical composition of Escherichia coli. Microbial Ecology 52:26-33.

Synergistic Activities

- American Society of Limnology and Oceanography Board of Directors (Member at large; 2008-present)
- Director of Undergraduate Studies for Dept. EEB, University of Minnesota (2008-present)
- PI for Global Change Ecology, NSF-REU Site, Itasca Biological Station and Laboratories (2008-)
- Co-Chair (with Samantha Joye) of the American Society of Limnology and Oceanography's Aquatic Sciences Meeting in Feb 2003, Salt Lake City.
- Mentor for American Society for Limnology and Oceanography Committee for Under-represented Minorities in Limnology and Oceanography. (1995)

Collaborators (in the past 48 months)

Bopaiah Biddanda, Grand Valley State University, James Elser, Arizona State University, Dan Engstrom and Mark Edlund, Minnesota Science Museum, Thomas Johengen, University of Michigan, Peter Lavrentyev, Akron University, Kris McNeill ETH Switzerland, Rose M. Cory, University of North Carolina, Noel Urban, Michigan Tech University, Galen McKinley, University of Wisconsin, Kevin Theissen, University of St. Thomas, Kyle Zimmer, University of St. Thomas, Andre Amado, University of Natal-Brazil, James Waples, University of Wisconsin-Milwaukee, Val Klump, University of Wisconsin-Milwaukee, Kirk O. Winemiller, Texas A&M University.

Advisors and advisees

Robert T. Heath, Kent State University, M.Sc.; Robert G. Wetzel (deceased), Ph.D.; Wayne Gardner, Univ. Texas, Postdoctoral research supervisor.

Advisees and Related Experience:

Advisees: Casey Moore, M.Sc., Kelly Gloger, M.Sc., Michael Suplee, M.Sc., Ph.D., David E. Shormann, Ph.D., Yesim Buyukates, M.Sc., Edward Hall, Ph.D., Edward Stets, Ph.D., Brian Johnson (M.Sc.), Jon Kenning (Ph.D.), Leah Domine (Ph.D.)

SARAH E. EVANS

Natural Resource Ecology Laboratory ▪ Colorado State University ▪ Fort Collins, CO 80523
Sarah.evans@colostate.edu ▪ (256)337-2482 ▪ http://warnercnr.colostate.edu/~sarahe/index.htm

Education

PhD, Graduate Degree Program in Ecology, Colorado State University *2007-present*
Advisors: Matthew Wallenstein and Ingrid Burke (University of Wyoming)
Emphasis: Biogeochemical and soil microbial response to changes in rainfall patterns

BA, Biology, Grinnell College, Grinnell, Iowa *2001-2005*
Honors thesis: Population genetics and ecology of the mushroom *Morchella esculenta* (morel)
Semester abroad, Costa Rica and Nicaragua (OTS and Duke University) *2004*
Juneau Icefield Research Program, Alaska/Canada (University of Idaho) *2003*

Grants, Awards, and Fellowships

- Editor's Choice Award for 2011 publication in *Journal of Ecology* Issue 6, November, 2011
- Argonne Soils Metagenomics Workshop Travel Grant, 2010, 2011 ($500)
- Best Student Presentation in the Biogeosciences Section at ESA, 2011 ($500)
- NSF) Doctoral Dissertation Improvement Grant, 2011 ($14,742)
- American Geophysical Union (AGU) Travel Award to attend annual meeting, 2010 ($500)
- Graduate Degree Program in Ecology (CSU) Travel Grant to attend and present at the International Symposium for Microbial Ecology (2010, $490) and Ecological Soc. of America Meeting (2011, $450)
- NSF Graduate Research Fellowship, 2009-2012 ($90,000 over three years)
- Natural Resource Ecology Laboratory Francis Clark Soil Biology Scholarship, 2009 ($4,000)
- Colorado State University Fellowship to present at the 2009 International Conference on Soil Organic Carbon ($500)
- NSF East Asia & Pacific Summer Inst (EAPSI) for summer research in China, 2008 ($5,000)
- Colorado State Univ. GDPE recruitment award, 2007 ($2,000)
- Elsie Stoffer Award for biological study abroad in Costa Rica, 2004 ($1,000)
- Grinnell College Environmental Studies Internship Grant, 2003 ($2,000)
- Grinnell College Trustee Merit-based scholarship, 2001 ($20,000 over 4 years)

Publications

Evans, SE and MD Wallenstein. 2011. Soil microbial community response to drying and rewetting stress: does historical precipitation regime matter? *Biogeochemistry.* doi: 10.1007/s10533-011-9638-3

Conant, RT, MG Ryan, GI Ågren, HE Birge, EA Davidson, PE Eliasson, **SE Evans**, SD Frey, CP Giardina, F Hopkins, R Hyvönen, MUF Kirschbaum, JM Lavallee, J Leifeld, WJ Parton, JM Steinweg, MD Wallenstein, JÅ Martin Wetterstedt, and MA Bradford. 2011. Temperature and soil organic matter decomposition rates – synthesis of current knowledge and a way forward. *Global Change Biology* **17**: 3392–3404. doi: 10.1111/j.1365-2486.2011.02496.x

Evans, SE , KM Byrne, IC Burke and WK Lauenroth. 2011. Defining the limit to resistance in a drought tolerant grassland: long-term severe drought significantly reduces the dominant species and increases ruderals. *Journal of Ecology* **99**: 1500-1507. doi: 10.1111/j.1365-2745.2011.01864.x. **Received Issue 6 (November 2011) Editor's Choice Award*

Evans, SE, IC Burke, WK Lauenroth. 2011. Controls on soil organic carbon and nitrogen in Inner Mongolia, China: a cross-continental comparison of temperate grasslands. *Global Biogeochemical Cycles* **25:** GB3006. doi:10.1029/2010GB003945

In prep:

Evans, SE, IC Burke, 2011. Carbon and nitrogen decoupling under long-term drought in the shortgrass steppe: implications for increased nutrient loss under drought recovery. *Ecosystems*

Evans, SE, P Brewer, JG Ernakovich, JM Steinweg, JC von Fischer. 2011. Anoxic microsites in oxic soils: evidence and implications for ecosystem function. *Ecology Letters*

Selected presentations

Evans, SE, MD Wallenstein. 2011. Does long-term drought alter the response of soil microbial communities to moisture? Argonne Soil Metagenomics Workshop. Bloomingdale, IL (*invited oral presentation)*

Evans, SE, MD Wallenstein. 2011. Does long-term drought alter the response of soil microbial communities to moisture? Ecological Society of America Annual Meeting. Austin, TX (oral presentation). **Received the Biogeosciences Section Best Student Presentation Award at ESA.*

Evans, SE, IC Burke, WK Lauenroth. 2010. Controls on soil organic carbon and nitrogen in Inner Mongolia, China: a cross-continental comparison of temperate grasslands. American Geophysical Union (AGU) Annual Meeting, San Francisco, CA *(presentation).*

Evans, SE and MD Wallenstein. 2010. Soil microbial response to drying-rewetting stress: Do microorganisms adapt to altered rainfall timing? International Symposium for Microbial Ecology, Seattle, WA *(poster)*

Wallenstein, MD. **Evans, SE.** 2010. Microbial adaptations to environmental change: a moving target for global change ecology. Ecological Society of America annual meeting, Pittsburgh, PA. *(invited, symposium)*

Evans, SE, IC Burke, WK Lauenroth, JC von Fischer. 2009. The effect of long-term drought on C and N linkages in the shortgrass steppe. Ecological Society of America annual meeting, Albuquerque, NM *(poster)*

Evans, SE. 2006. Ethics and Protocols of Social and Environmental Research in Southern Africa, Winter Term course, "Protocols in International Research" University of Virginia, Charlottesville, VA *(presentation)*

Evans, SE and KM Jacobson. 2005. Intrapopulational genetic variation in *Morchella esculenta.* Iowa Academy of Sciences Meeting, Des Moines, IA *(poster)*

Evans, SE. 2004. Snow mass balance on the Juneau Icefield: climatic implications from long-term data. Juneau Icefield Research Program annual summer research symposium. Atlin, British Colombia, Canada (*presentation)*

Service

- Reviewer, *Soil Biology and Biochemistry, Global Change Biology, Plant and Soil, Biogeochemistry*
- Natural Resource Ecology Laboratory Graduate Student Representative, 2010-2011
- Volunteer, Colorado State University GetWET Program.This program leads field trips for middle and high school students on hydrology, water management, and aquatic ecology in Fort Collins
- Newsletter Editor, Graduate Degree Program in Ecology, Colorado State University, 2009-2010
- Student Symposium Organizer, Front Range Student Ecology Symposium, 2008-2010 (Secretary, 2009)

JANET K. JANSSON

Professor and Senior Staff Scientist, Ecology Department
Earth Sciences Division, Lawrence Berkeley National Laboratory, Berkeley, CA 94720
Phone: (510) 486-7487, FAX: (510)-486-7152, email: jrjansson@lbl.gov

Professional preparation

New Mexico State University	B.S. Biology and Soil Science	1980
Colorado State University	M.S. Soil Microbiology	1983
Michigan State University	Ph.D. Microbial Ecology	1988
Stockholm University	Postdoc. Biochemistry	1991

Appointments

2007-present	Senior Staff Scientist, Earth Sciences Division, Lawrence Berkeley National Lab., CA 20% appointment at the Joint Genome Institute (JGI), LBNL 20% appointment at the Joint Bioenergy Institute (JBEI), LBNL
2003-present	Professor (Chair) of Environmental Microbiology, SLU, Uppsala, Sweden
2006-2007	Vice Dean (25%), Swedish University of Agricultural Sciences (SLU), Uppsala
2000-2002	Professor of Microbiology, Section for Natural Sciences, Södertörn University, Sweden
1998-1999	Associate Professor, Section for Natural Sciences, Södertörn University College
1996-1997	Assistant Professor, Department of Biochemistry, Stockholm University, Sweden

Other Experience and Commissions of trust

- Vice Dean, Faculty of Natural Resources and Agricultural Sciences, SLU, Sweden (2007)
- Member of the Swedish Royal Academy of Sciences, National Committee for Biology (2006-2007)
- Swedish representative for the International Union of Biological Sciences (2006-2007)
- Coordinator of EU project: "MAREP, Marker/reporter genes in Microbial Ecology" with 26 partners from 11 different countries (1997-1999)
- Coordinator of the Swedish Network of Excellence: Uppsala Microbiomics Center (2006-2007)
- Member of the Swedish Gene Technology Advisory Board (2000-2006)
- Conference organizer for the 10th Symposium on Bacterial Genetics and Ecology (BAGECO-10), with 320 participants. Uppsala, Sweden. 2009; Vice-Chair of the Gordon Conference on Applied and Environmental Microbiology. Mount Holyoke, MA, 2011 (elected Chair for 2013); Elected Co-Chair of the ASM Beneficial Host-Microbe conference, San Francisco, CA, 2012.
- LBNL Professional staff committee (from 2011)
- Program Lead for Environmental Microbiology, Earth Sciences Division, LBNL (from 2011)

Current research support

- US Department of Energy (DOE), BER: "*Meta-"omics" analysis of microbial carbon cycling responses to altered rainfall inputs in native prairie soils"*. 2010-2012 Jansson (Co-PI) PI: David Myrold, OSU, Jansson Co-PI in addition to Ari Jumpponen & Charles Rice (KSU, Susannah Tringe (JGI) Robert Hettich & Nathan VerBerkmoes (ORNL). $200,000/yr
- US Department of Energy, Strategic LDRD: "*Fundamental research on biological carbon capture and soil carbon stabilization*". 2010-2012. Jansson (Co-PI); PI, Margaret Torn (LBNL). $250,000/yr
- British Petroleum (BP) Energy Biosciences Institute: Microbially Enhanced Hydrocarbon Recovery (MEHR)- Systems Biology Program. 2009 – 2019. Role: Co-PI with other LBNL staff: Terry Hazen, Harry Beller, Gary Andersen and Eoin Brodie. LBNL budget is $1,600,000/Yr
- BP-Gulf oil spill project: Use of omics to assess the impact of theGulf oil spill on microbial community composition and function. 2010-2011. Jansson Co-PI and coordinator of "omics" analyses. Project coordinator: Terry Hazen, LBNL. LBNL budget is approx. $1,000,000/yr.

- US National Institute of Health: *Metagenomic Analysis of the Structure and Function of the Human Gut Microbiota in Crohn's Disease*. 2009-2011. Role, Co-PI with Claire Fraser-Liggett (Univ. of Maryland, USA). $210,000/yr.
- DOE/ Joint Genome Institute (JGI) Community Sequencing Project: *Metagenomics of permafrost soil – implications for climate change*. 2010-2011. Jansson, (Co-PI); Project coordinator: Mark Waldrop, USGS. Sequencing costs covered by JGI.
- NSF Research Coordination Network, *TerraGenome-The Soil Metagenome Network*. 2011-2015. Jansson, PI & liason with Earth Microbiome Project. Project coordinator: David Myrold (OSU) $500,000 total.
- *Earth Microbiome Project* (funded through Illumina, Eppendorf, MoBio, Argonne National Laboratory & University of Colorado, Boulder): Jansson, Steering committee member and PI in charge of soil projects for EMP, including sample collection, storage and processing.
- General Mills: *Impact of dietary carbohydrate on the gut microbiota compostion and function.* 2011-2012. Jansson PI. $275,000 total.
- DOE Joint Bioenergy Institute (JBEI) *Microbial Communities*. Jansson, PI. 2011-2012. Jansson 20% salary , plus postdoc funded through JBEI. Approx. $250,000/yr.

Assignments as member of editorial boards for scientific journals (from 1999)
- Co-Editor-in-Chief of The ISME Journal (from 2009)
- Editor of FEMS Microbiology Ecology (1996-2004)
- Editorial Board of Applied and Environmental Microbiology (from 2005)
- Editorial Board of FEMS Microbiology Ecology (from 2006)
- Editorial Board of Environmental Microbiology (from 2006)
- Editorial Board of International Society of Microbial Ecology Journal (from 2007)
- Editorial Board of Current Opinion in Biotechnology (from 2011)

Current supervision of postdoctoral fellows
- Neslihan Tas [2011-2012]
- Maude David [2010-2012]
- Regina Lamendella [2009-2011]
- Olivia Mason [2009-2012]
- Rachel Mackelsprang [2009-2010, co-supervisor; Eddy Rubin, JGI, main supervisor)
- Jenni Hultman [2010-2012]
- Jacob Baelum [2010-2012]
- Emmanuel Prestat [2011-2012]

Five recent publications (out of approx. 100 total)
1) Mackelprang, R., M.P. Waldrop, K.M. DeAngelis, K.L. Chavarria, S.J. Blazewicz, E.M. Rubin and J.K. Jansson. Deep metagenome sequencing illuminates permafrost response to thaw. Nature. doi: 10.1038/nature10576
2) Jansson, J.K. (2011) Towards "Tera-Terra": Terabase sequencing of terrestrial metagenomes. Microbe. 6:309-315.
3) Lu, Z., Y. Deng, J. D. Van Nostrand, Z. He, J. Voordeckers, A. Zhou, Y-J. Lee, O. Mason, E. Dubinsky, K. Chavarria, L. Tom, J. Fortney, R. Lamendella, J.K. Jansson, P.D'haeselleer, T.C. Hazen and J. Zhou. 2011. Microbial gene functions enriched in the Deepwater Horizon deep-sea oil plume. The ISME Journal (*in press*).
4) Hazen, T.C., E.A. Dubinsky, T.Z. DeSantis, G.L.Andersen, Y.M. Piceno, N. Singh, J.K. Jansson, et al. (2010) Deep-sea oil plume enriches indigenous oil-degrading bacteria. *Science*. 330:204-208.
5) Chourey, K., J.K. Jansson, N. VerBerkmoes, M. Shah, K. Chavarria, L. Tom, E. Brodie and R. Hettich. (2010) A direct cellular lysis/protein extraction protocol for soil metaproteomics. Journal of Proteome Research. 9:6615-6622.

Stuart Edward Jones

Department of Biological Sciences
University of Notre Dame, South Bend, IN
Email: sjones20@nd.edu Web: http://www.nd.edu/~sjones20

EDUCATION

University of Wisconsin-Madison	Biology	B.S., 2003
University of Wisconsin-Madison	Limnology and Marine Sciences	Ph.D., 2008

APPOINTMENTS

2010-present	Assistant Professor, Department of Biological Sciences, University of Notre Dame, South Bend, IN
2008-2010	Postdoctoral Research Associate, Michigan State University, W.K. Kellogg Biological Station, Hickory Corners, MI
2003-2008	Research and Teaching Assistant, University of Wisconsin, Madison, WI

FIVE MOST RELEVANT PUBLICATIONS

Newton RJ, **Jones SE**, Eiler A, McMahon KD, Bertilsson S. 2011. A Guide to the Natural History of Freshwater Lake Bacteria. Microbiology and Molecular Biology Reviews, 75: 14-49.

Lennon JT and **Jones SE**. 2011. Microbial Seed Banks: The Ecological and Evolutionary Implications of Dormancy. Nature Reviews Microbiology, 9: 119-130.

Jones SE and Lennon JT. 2010. Dormancy Contributes to the Maintenance of Microbial Diversity. Proceedings of the National Academy of Sciences, 107: 5881-5886.

Jones SE and McMahon KD. 2009. Species-Sorting May Explain an Apparent Minimal Effect of Immigration on Freshwater Bacterial Community Dynamics. Environmental Microbiology, 11: 905-913.

Jones SE, Newton RJ, McMahon KD. 2009. Evidence for Structuring of Bacterial Community Composition by Organic Carbon Source in Temperate lakes. Environmental Microbiology, 11: 2463-2472.

FIVE OTHER RELATED PUBLICATIONS

Jones SE, Solomon CT, Weidel BC. In Review. Subsidy or subtraction: How do terrestrial inputs influence consumer production in lakes?

Ball BA, Kominoski JS, Adams HE, **Jones SE**, Kane ES, Loecke TD, Mahaney WM, Martina JP, Prather CM, Robinson TMP, Solomon CT. 2010. Direct and terrestrial vegetation-mediated effects of environmental change on aquatic ecosystem processes. BioScience, 60: 590-601.

Jones SE and Lennon JT. 2009. Evidence for Limited Microbial Transfer of Methane in Planktonic Food Webs. Aquatic Microbial Ecology, 58: 45-53.

Jones SE, Kratz TK, Chiu CY, McMahon KD. 2009. Typhoon Disturbance Patterns Drive Annual CO_2 Flux from a Sub-Tropical, Humic Lake. Global Change Biology, 15: 243-254.

Jones SE, Chiu CY, Kratz TK, Wu JT, Shade A, McMahon KD. 2008. Typhoons Cause Predictable Change in Freshwater Bacterial Communities. Limnology and Oceanography, 53: 1319-1326.

SYNERGISTIC ACTIVITIES

Mentor, Intel International Science Fair competition

Co-organizer, "Have Microbes Read the Book? Ecological Theory Applied to Microbial Systems"; Ecological Society of America Annual Meeting 2008

Instructor, PreCollege Enrichment Opportunity Program for Learning Excellence (PEOPLE), University of Wisconsin-Madison

Reviewer for Hydrobiologia, Journal of Plankton Research, Journal of Vegetation Science, Aquatic Microbial Ecology, Limnology and Oceanography, Ecology, NSF, NOAA Sea Grant

Ad hoc reviewer and panelist for NSF

ADVISORS

Trina McMahon (Ph.D.), Jay Lennon (Postdoc)

COLLABORATORS AND COAUTHORS

T.C. Balser, University of Wisconsin
A.J. Burgin, Wright State University
C.Y. Chiu, Academia Sinica, Taiwan
S.K. Hamilton, Michigan State University
A.D. Kent, University of Illinois
T.K. Kratz, University of Wisconsin
C.T. Solomon, McGill University
A. Eiler, Upssala University
J.T. Lennon, Michigan State University
K.D. McMahon, University of Wisconsin
R.J. Newton, WATERS Institute
A. Shade, University of Wisconsin
E.W. Triplett, University of Florida
J.T. Wu, Academia Sinica, Taiwan
S. Bertilsson, Upssala University
B.C. Weidel, USGS

ADVISEES

Will West, Ph.D. in progress; 2010 – present
Patrick Kelly, Ph.D. in progress; 2011 – present
Dan Liu, M.S. in progress; 2011-present

JOSHUA P. SCHIMEL

Environmental Studies Program &
Dept. Ecology, Evolution, and Marine Biology
University of California
Santa Barbara, CA 93106

Education

Ph.D. 1987 University of California, Berkeley. Soil Science
B.A. 1979 Middlebury College, Chemistry, Cum Laude

Employment

2004- Chair, Environmental Studies Program, University of California, Santa Barbara
1995- Professor (2000); Associate Prof. (1996) and Asst. Prof. (1995) of Soil and Ecosystem Ecology, University of California, Santa Barbara
2005 Directeur de Recherche Associé, Centre d'Ecologie Fonctionnelle & Evolutive, Centre Nationale de la Recherche Scientifique, Montpellier, France.
1989-94 Asst. Prof. of Microbial Ecology, University of Alaska-Fairbanks

Recognition

Erskine Fellow. University of Canterbury, New Zealand. 2008.
Aldo Leopold Leadership Fellow. 2006
Outstanding Professor. UCSB (Awarded by Residence Hall Students) 1998
Leverhulme Commonwealth/USA Visiting Fellowship, 1987

Professional service (selected since 2000)

Chair, Publications Committee, Ecological Society of America. 2011-.
Member-at-large. Governing Board of the Ecological Society of America. 2008-11.Chief Editor, Soil Biology & Biochemistry: 2007-; Subject Editor, 1997-2007.
Editor-in-Chief: Syntheses and Emerging Ideas Section, Biogeochemistry, 2005-10.
Chair, NSF Arctic System Science Steering Committee. 2006-10.
Executive Committee, NSF Advisory Committee on Environmental Research and Education (ACERE), 2004. Member 2002-2005.
Chair, NSF Office of Polar Programs Advisory Committee, 2004. Member 2002-2005.

Publications (Selected):

Book: Schimel, J. 2011. ***Writing Science***: *How to write papers that get cited and proposals that get funded*. Oxford University Press. 222 pp

1. Ge, Y. J.P. Schimel, and P.A. Holden. 2011. Evidence for Negative Effects of TiO_2 and ZnO Nanoparticles on Soil Bacterial Communities. *Environmental Science & Technology*. 45: 1659–1664.
2. Schimel, J.P., J.Å. M. Wetterstedt , P. A. Holden, and S.E. Trumbore. 2011. Drying/rewetting cycles mobilize old C from deep soils from a California annual grassland. *Soil Biology & Biochemistry*, 43: 1101-1103.
3. Philippot, L., S. G. E. Andersson, T. J. Battin, J. I. Prosser, J. P. Schimel, W.B. Whitman and S. Hallin. 2010. The ecological coherence of high bacterial taxonomic ranks. *Nature Reviews Microbiology*. doi:10.1038/nrmicro2367.
4. Li, X., A.E. Miller, T. Meixner, J.P. Schimel, J.M. Melack, and J.O. Sickman. 2010. Adding an empirical factor to better represent the rewetting pulse mechanism in a soil biogeochemical model. *Geoderma* 159: 440–451.

5. Roux-Michollet, D.D., J.P. Schimel and P.A. Holden. 2010. Pushing the limits for amplifying BrdU-labeled DNA encoding 16S rRNA: DNA polymerase as the determining factor. *J. Microbiological Methods*. 83: 312-316.
6. Kutsch, W.L., J. Schimel, K. Denef. 2010. Measuring soil microbial parameters relevant for soil carbon fluxes. In: *Integrated Methodology on soil carbon flux measurements*. Kutsch W.L., M. Bahn, A. Heinemeyer (Eds.) Cambridge University Press. Pp. 169-186.
7. Lawrence, C.R., J.C. Neff, and J.P. Schimel. 2009. Does adding microbial mechanisms of decomposition improve soil organic matter models? A comparison of four models using data from a pulsed rewetting experiment. *Soil Biology & Biochemistry* 41: 1923-1934.
8. Manzoni, S., A. Porporato, and J.P. Schimel. 2008. Soil heterogeneity in lumped mineralization-immobilization models. *Soil Biology & Biochemistry*. *40: 1137-1148.*
9. Xiang, S-R., A. Doyle, P.A. Holden, and J.P. Schimel. 2008. Drying and rewetting effects on C and N mineralization and microbial activity in surface and subsurface California grassland soils. *Soil Biology & Biochemistry.* 40: 2281-2289.
10. Colman, B.P., N. Fierer, and J.P. Schimel. 2007. Abiotic nitrate incorporation in soil: is it real? Biogeochemistry. 84: 161-169.
11. Numata, I., D.A. Roberts, Y. Sawada, O.A. Chadwick, J.P. Schimel, H. Sawada, and J.V. Soares. 2007. Characterization of pasture biophysical properties and the impact of grazing intensity using remotely sensed data. *Remote Sensing of the Environment*. 109: 314–327.
12. Schimel, J.P., T.C. Balser, and M. Wallenstein. 2007. Microbial stress-response physiology and its implications for ecosystem function. *Ecology*. 88: 1386-1394.
13. Fierer, N., B. P. Colman, J. P. Schimel, and R. B. Jackson. 2006. Predicting the temperature dependence of microbial respiration in soil: A continental-scale analysis, *Global Biogeochem. Cycles*, 20, GB3026, doi:10.1029/2005GB002644.
14. Chapin, F. S. III, M. Sturm, M. C. Serreze, J. P. McFadden, J. R. Key, A. H. Lloyd, A. D. McGuire, T. S. Rupp, A. H. Lynch, J. P. Schimel, *et al*. 2005. Role of Land-Surface Changes in Arctic Summer Warming. *Science* 310: 657-660.
15. Schimel, J.P., J. Bennett, and N. Fierer. 2005. Microbial community composition and soil N cycling: is there really a connection? In: *Biological diversity and function in soils*. Bardgett, R.D., D.W. Hopkins, and M.B. Usher (Eds.) Cambridge University Press. *Pp. 171-188.*
16. Weintraub, M.N., and J.P. Schimel. 2005. Nitrogen cycling, spread of shrubs control changes in carbon balance of arctic tundra ecosystems. *BioScience.* 55: 408-415.
17. Sturm, M. J. Schimel, G. Michaelson, J. Welker, S.F. Oberbauer, G.E. Liston, J. Fahnestock, V.E. Romanovsky. 2005. Winter biological processes could help convert Arctic tundra to shrubland. *BioScience* 55: 17-26.
18. Schimel, J.P. 2004. Playing scales in global biogeochemistry: from microbial ecology to global cycles. *Proceedings of the National Academy of Science* 101: 12400-12401.
19. Schimel, J. P., and J. Bennett. 2004. Nitrogen mineralization: challenges of a changing paradigm. *Ecology* 85: 591-602.
20. Schimel, J.P. and M.N. Weintraub. 2003. The implications of exoenzyme activity on microbial carbon and nitrogen limitation in soil: a theoretical model. *Soil Biology & Biochemistry* 35: 549-563.
21. Schimel, J.P. Biogeochemical models: implicit vs. explicit microbiology. 2001. In: *Global Biogeochemical Cycles in the Climate System*. E.D. Schulze, S.P. Harrison, M. Heimann, E.A. Holland J.J. LLoyd, I.C. Prentice, and D. Schimel (Eds). Academic Press. Pp. 177-183.
22. Schimel, J.P. and J. Gulledge. 1998. Microbial Community Structure and Global Trace Gases. *Global Change Biology* 4: 745-758.
23. Schimel, J. 1995. Ecosystem consequences of microbial diversity and community structure. In*: Arctic and Alpine Biodiversity: patterns, causes, and ecosystem consequences*. F.S. Chapin and C. Korner (Eds.). Springer-Verlag, Berlin. pp. 239-254.

Curriculum Vitae

MARK P. WALDROP
United States Geological Survey
345 Middlefield Rd, MS 962
Menlo Park, CA 94025
Tel: (650) 329-5005 • **Fax:** (650) 329-4920 • **Email:** mwaldrop@usgs.gov

Education and Training.
University of California at Berkeley, Ph.D., Soil Science, 2002
University of California at Berkeley, M.S., Soil Science, 1997
New Mexico State University, B.S. Biology/Ecology, and B.S. Soil Science, 1995

Research and Professional Experience:.
2007- current Research Soil Scientist, USGS, Menlo Park, CA.
2005-2007 Mendenhall Research Fellow, USGS, Menlo Park, CA.
2002-2004 Postdoctoral Fellow, The University of Michigan

Publications (last 5 years)

Mackelprang, R. **Waldrop, M.P**. DeAngelis, K.M., David, M.M. Chavarria, K.L., Blazewicz, S.J., Rubin, E.M., and Jansson, J.K. 2011. Deep metagenome sequencing illuminates rapid permafrost response to thaw. Nature, doi:10.1038/nature10576.

Petersen, D.G., Blazewicz, S., Herman, D.J., Firestone, M., Turetsky, M. and **M.P. Waldrop**. 2011. Abundance of microbial genes associated with nitrogen cycling as indices of biogeochemical process rates across a vegetation gradient in Alaska. Environmental Microbiology. In Press.

Graham, D.E., Wallenstein, M.D., Vishnivetskaya1, T.A., **Waldrop, M.P**., Phelps, T.J., Pfiffner, S.M., Onstott, T.C., Whyte, L.G., Rivkina, E.M., Gilichinsky, D.A., Elias, D.A., Mackelprang, R., VerBerkmoes, N.C., Hettich, R.L., Wagner, D., Wullschleger, S.D., Jansson, J.K., 2011. Commentary: Microbes in Thawing Permafrost: The Unknown Variable in the Climate Change Equation. Journal of the International Society for Microbial Ecology. |doi:10.1038/ismej.2011.163.

Grosse, G., J. Harden, M. Turetsky, A. D. McGuire, P. Camill, C. Tarnocai, S. Frolking, E. A. G. Schuur, T. Jorgenson, S. Marchenko, V. Romanovsky, K. P. Wickland, N. French, **M. Waldrop**, L. Bourgeau-Chavez, and R. G. Striegl (2011), Vulnerability of high-latitude soil organic carbon in North America to disturbance, J. Geophys. Res., 116, G00K06. doi:10.1029/2010JG001507.

Treseder, K.K., Balser, T.C., Bradford, M.A., Brodie, E.L., Dubinsky, E.A., Eviner, V.T., Hofmockel, K.S., Lennon, J.T., Levine, U.Y., MacGregor, B.J., Pett-Ridge, J., **Waldrop, M.P.**, 2011. Integrating microbial ecology into ecosystem models: Challenges and priorities. . Biogeochemistry DOI: 10.1007/s10533-011-9636-5.

Waldrop, M.P., Wickland, K, Berhe, A., White III, R., Harden, J., and V. Romanovsky. 2010. Molecular investigations into a globally important carbon pool: permafrost-protected carbon in Alaskan soils. Global Change Biology doi: 10.1111/j.1365-2486.2009.02141.x

Allison, S.D., Weintraub, M.N., Gartner, T.B., and **Waldrop, M.P.** 2010. Evolutionary-economic principles as regulators of soil enzyme production and ecosystem function IN: Soil Enzymes. A. Varma and G. C. Shukla (eds.), Springer-Verlag.

Turetsky, M. R., C. C. Treat, **M. Waldrop**, J. M. Waddington, J. W. Harden, and A. D. McGuire. 2008. Short-term response of methane fluxes and methanogen activity to water table and soil warming manipulations in an Alaskan peatland. Journal of Geochemical Research- Biogeosciences, 113: G00A10, doi:10.1029/2007JG000496.

Waldrop, M.P., Harden, J.W. 2008. Interactive effects of wildfire and permafrost on microbial communities and soil processes in an Alaskan black spruce forest. Global Change Biology, 14: 2591–2602, doi: 10.1111/j.1365-2486.2008.01661.x

Sinsabaugh, R.L, Lauber, C., Weintraub, M., Ahmed, B., Allison, S., Crenshaw, C., Contosta, A., Cusack, D., Frey, S., Gallo, M., Gartner, T., Hobbie, S., Holland, K., Keeler, B., Powers, J., Stursova, M., Takacs-Vesbach, C., **Waldrop, M.**, Wallenstein, M., Zak, D., Zeglin, L., 2008. Reviews and Syntheses: Stoichiometry of soil enzyme activity at global scale. Ecology Letters 11: 1-13

Blackwood, C.B., **Waldrop, M.P.,** Zak, D.R., and R.L. Sinsabaugh. 2007. Molecular analysis of fungal communities and laccase genes in decomposing litter reveal differences among forest types but no impact of nitrogen deposition. Environmental Microbiology 9:5 1306-1316.

Other Experience and Professional Memberships

2005- American Geophysical Union (AGU)
2007- Affiliated Scientist, Bonanza Creek LTER, Alaska
2008- USGS Interdisciplinary Carbon Committee
2008- National Soil Carbon Network (NSCN), steering committee member
2008- North American Carbon Program (NACP), affiliated project lead
2010- Affiliate Faculty, University of Alaska, Fairbanks
2010- Permafrost Research Coordination Network (RCN) member
2011- Scenarios Network for Alaska Planning (SNAP) member
2012- International Permafrost Association (IPA), board member

Collaborators and Co-editors:

Bony Ahmed,George Aiken, Steve Allison, Asmeret Berhe, Chris Blackwood, Bonnie Keeler, Eoin Brodie, Robert Buruss, Chelsea Crenshaw, Mingshi Chen, Alexandra Contosta, Cristina Takacs-Vesbach, Daniela Cusack, Claudia Czimczik (Green), Richard Dick, Thomas Douglas Eric Sundquist, Eugenie Euskirchen, Zhaosheng Fan, Stephanie Faulkner, Mary Firestone,Serita Frey,Tracy Gartner,Robert Gleason, Marty Goldhaber, Brad Griffith, Nicole Gustine, Jennifer Harden, Keri Holland, Teresa Hollingsworth, JoAnn Holloway, Bill Holmes,Janet Janssen, Jason Neff, Torre Jorgenson, Glenn Juday, Evan Kane,Yousif Kharaka, Christian Lauber, Marcy Gallo,Jack Mcfarland, David McGuire, John Moore, Jennifer Powers, Vladimir Romanovsky, Stephanie Saari, Sarah Hobbie, Kate Scow, Robert Sinsabaugh, Dick Smith, Rob Streigl, Matt Sturm, Martina Stursova,Larry Tieszen, David Tilman, Claire Treat, Kathleen Treseder, Susannah Tringe, Merrit Turetsky, Guntram Von Kiparski, Mike Waddington, Matt Wallenstein, Michael Weintraub, Richard White, Kim Wickland, Bruce Wylie, Xiaomei Xu, Don Zak, Lydia Zeglin,

Microbial Indicators of Ecosystem Processes	**YEAR 1**[1]	**YEAR 2**
Approximate meeting dates [2]	September 2011	March 2012 August 2012
Number of Working Group participants	12	12
Total travel expenses (transportation)	9 members x $600 airfare = $5400 (3 members reside in Fort Collins) x 2 trips $10,800	$5400 - $10800 depending on 1 or 2 meetings in year 2
Total daily expenses (per diem meals, lodging) [3]	9 members x 6 days (2 travel days) x 2 trips = $ 15,120	$7,560-15,120
Number of visitor days[4]	108	54-108
Total daily expenses for Working Group	$15,120	$7,560-15,120
Scientific support (postdoc, student, other)[5]	30,600 (project support for Sarah Evans – postdoc)	na
Salary	20,000	na
Participant name and salary requested	Hall, Lennon, and Wallenstein (1 mo. each)	na
Page charge ($1,800 maximum)	$600	$1200
Working Group total expenses	$76,520	$14,160- $27,1120
	YEAR 1[1]	YEAR 2

1 Most Powell Center projects last two years.
2 Enter approximate dates. Scheduled dates will depend on availability of Powell Center resources.
3 In FY2012, Fort Collins per diem cost is $140/day ($56 for meals, $84 for lodging).
4 Number of visitor days = number of visitors x number of travel days.
5 USGS funds may be used to support salaries for Fellows, students, or other technical support up to a maximum of $50,600 per Working Group; NSF funds may not be used for salary.
Add rows to budget table, as needed.